Corequisite Math Support For Introductory Statistics

Adam Molnar
Department of Statistics
Oklahoma State University
adam.molnar@okstate.edu

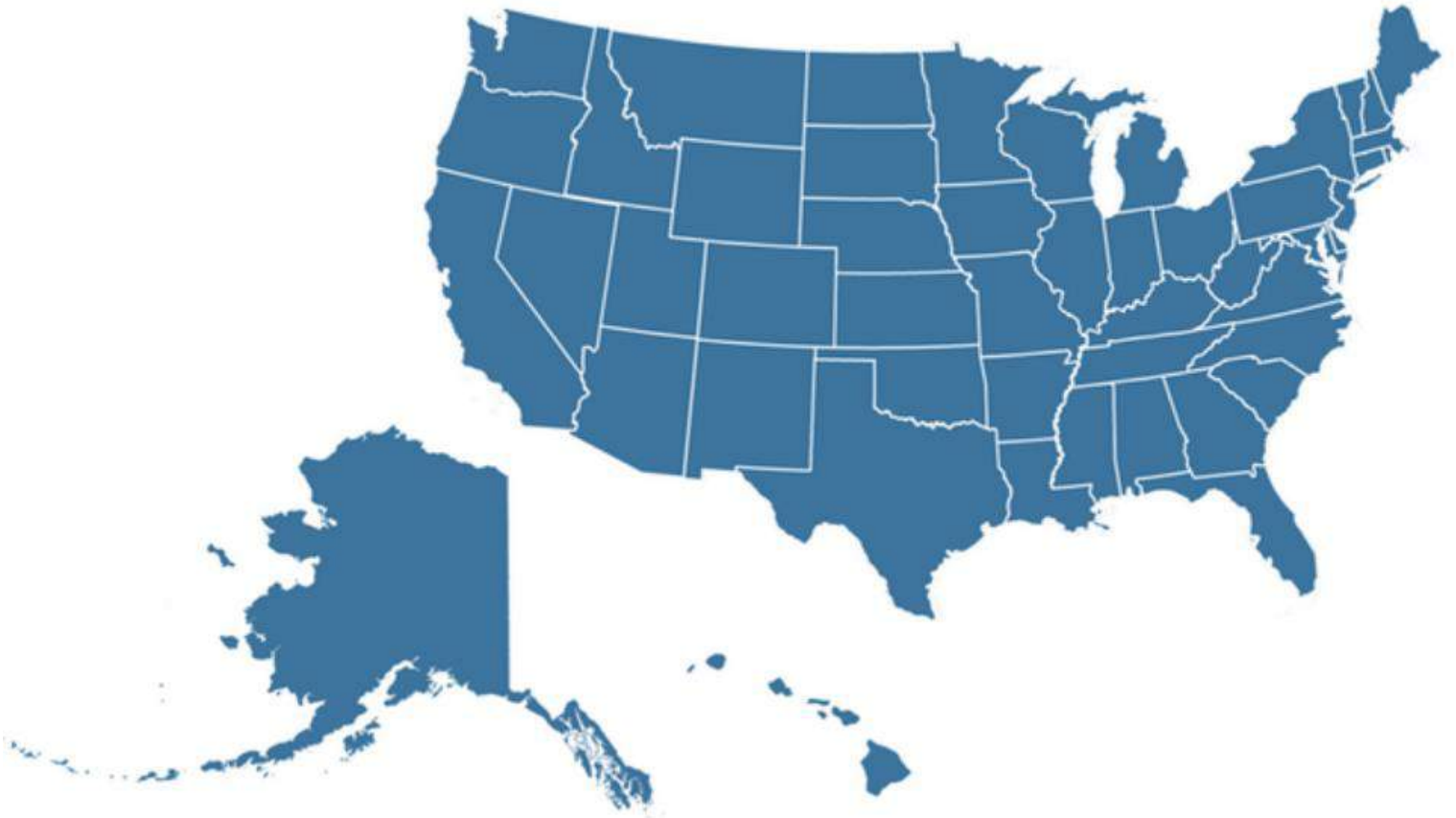
Christopher Sauer
Department of Mathematics
Cameron University
csauer@cameron.edu

A Little About You

- Corequisite: Students considered "underprepared" enroll in a transfer-level statistics course with extra concurrent support.
- We'll use Poll Everywhere for responses.

- Internet capable devices should respond at pollev.com/adammolnar929
- Dropbox link to this session: https://bit.ly/2WPjx8G

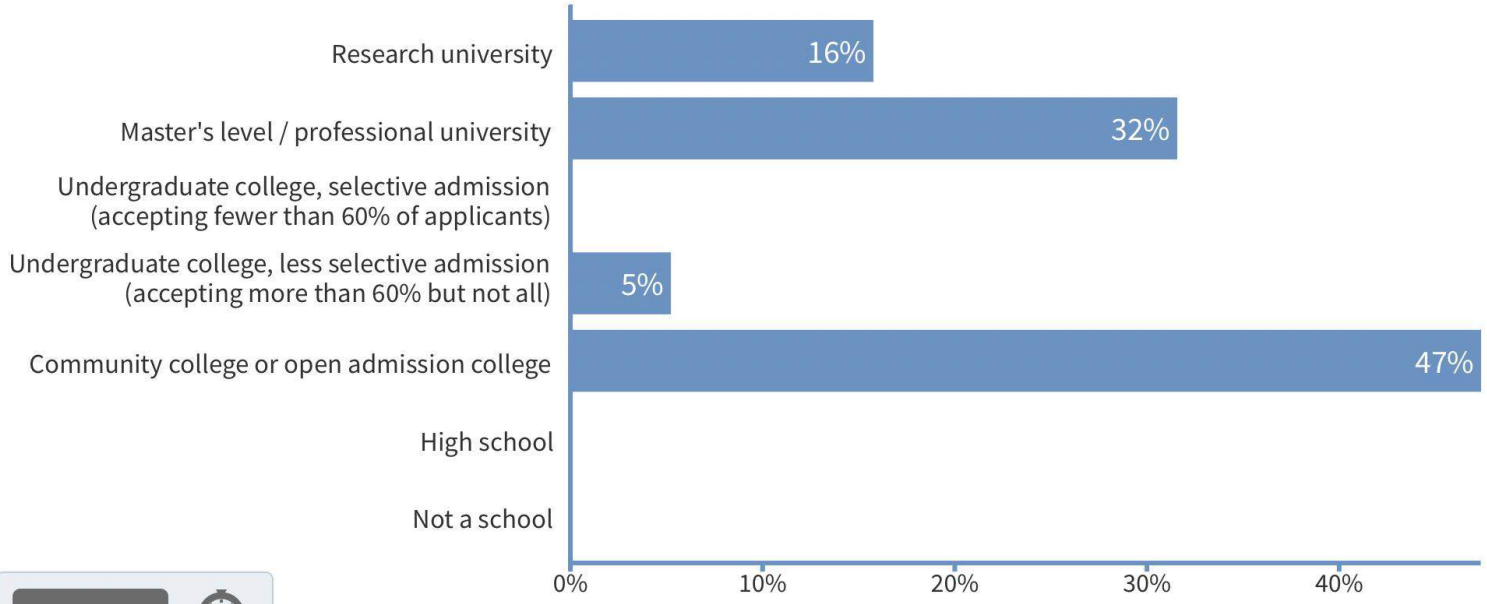
Where are you from? (Click on the map)



Back

Which of the following best describes your place of work?

When poll is active, respond at **PollEv.com/adammolnar929**



--:--

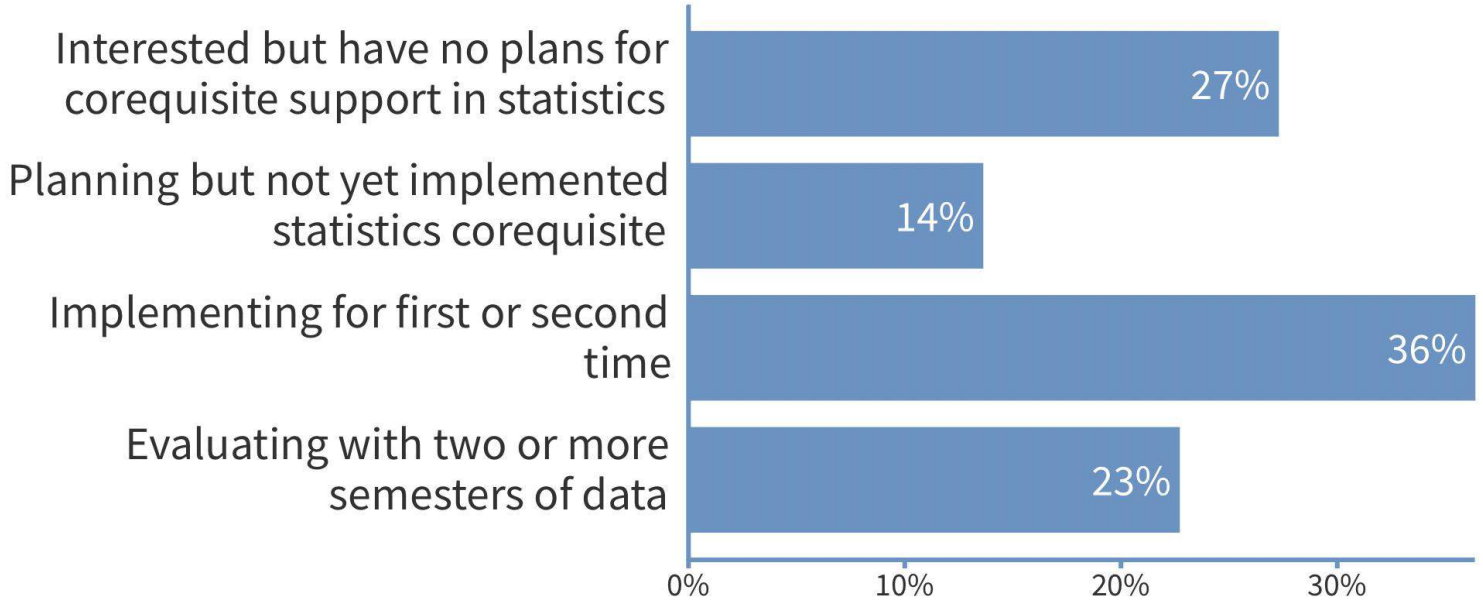
Poll Everywhere

Insert activity

Back

At what stage are you in the corequisite process for statistics?

When poll is active, respond at **PollEv.com/adammolnar929**

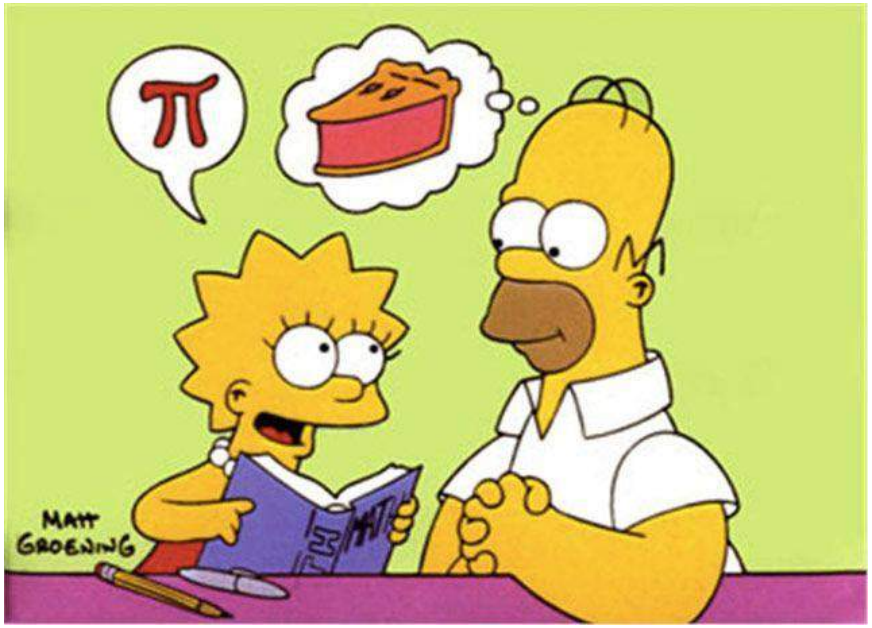


Poll Everywhere

Insert activity

More About Your Students

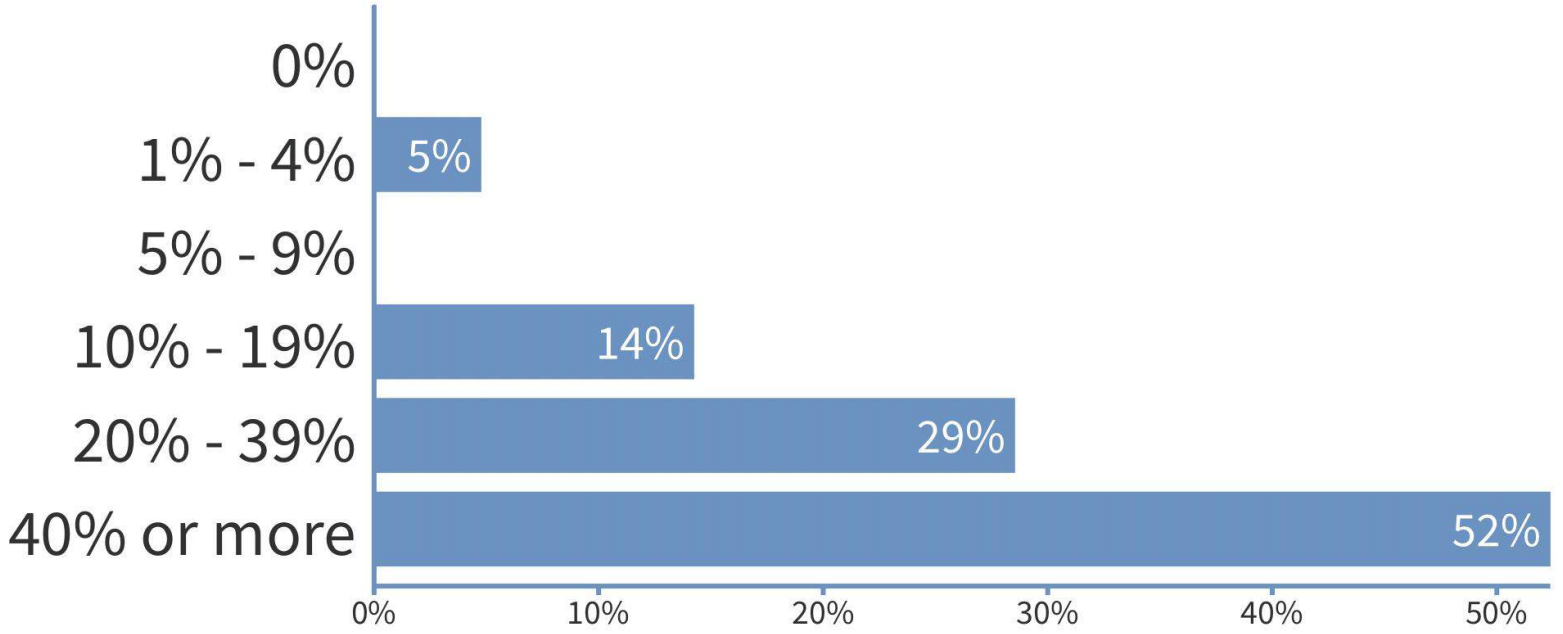
- Some colleges enroll students with strong math histories and few other commitments. Corequisite support is unlikely to be necessary for these students.
- Others do not.



Back

What percentage of students in your courses work for pay 20 or more hours a week?

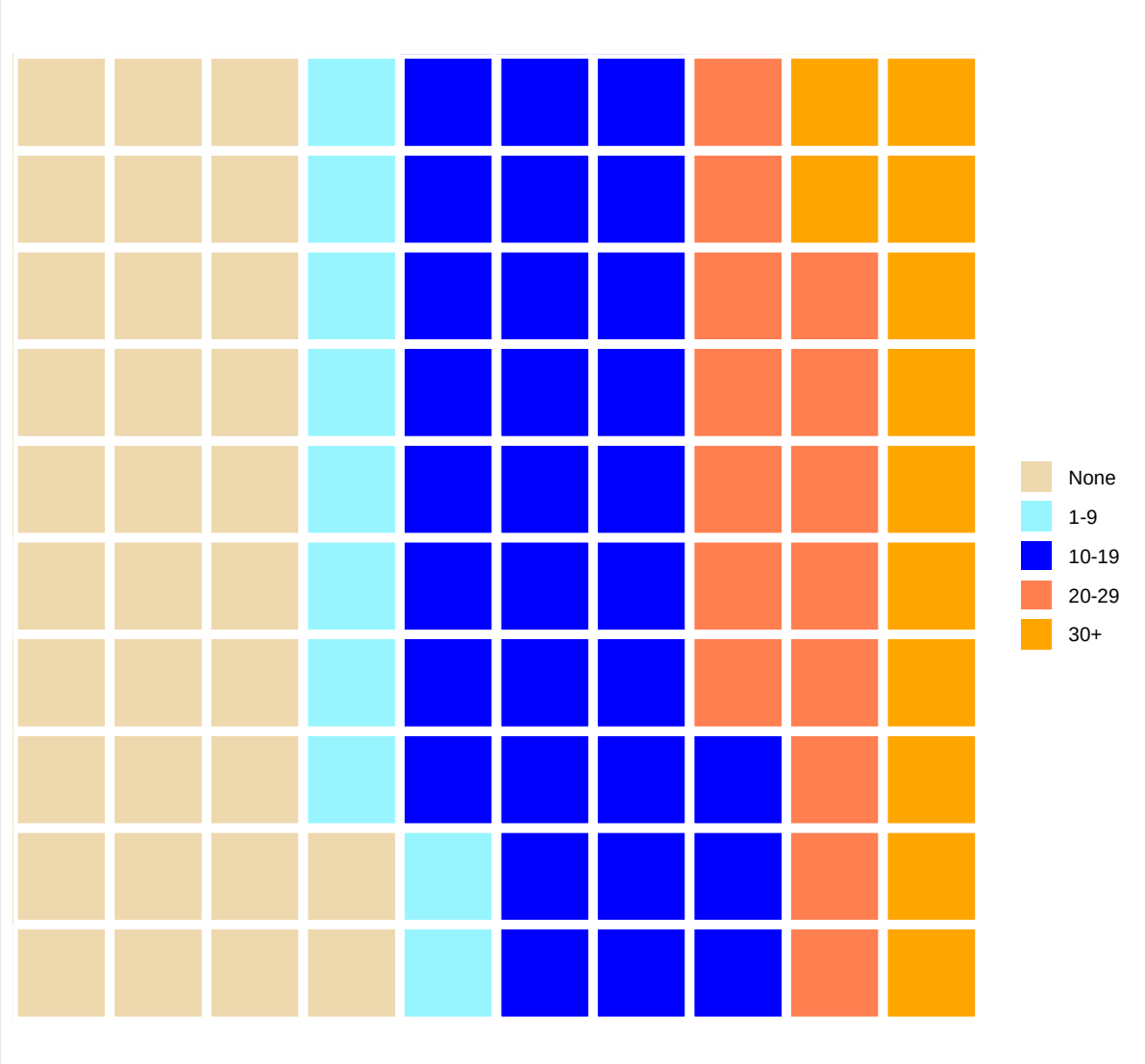
When poll is active, respond at **PollEv.com/adammolnar929**



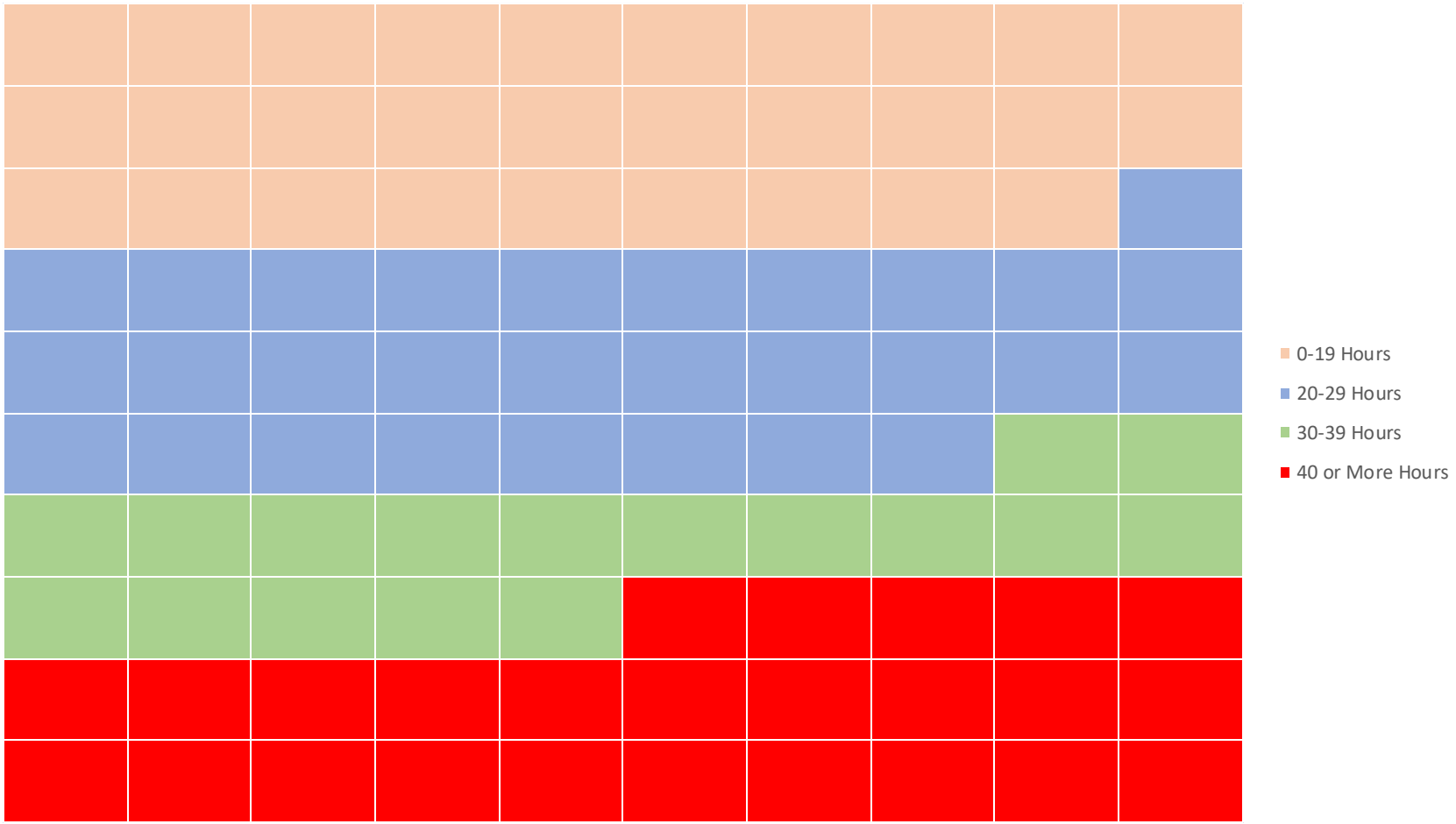
Poll Everywhere

Insert activity

Oklahoma State: 27% work 20+ hours



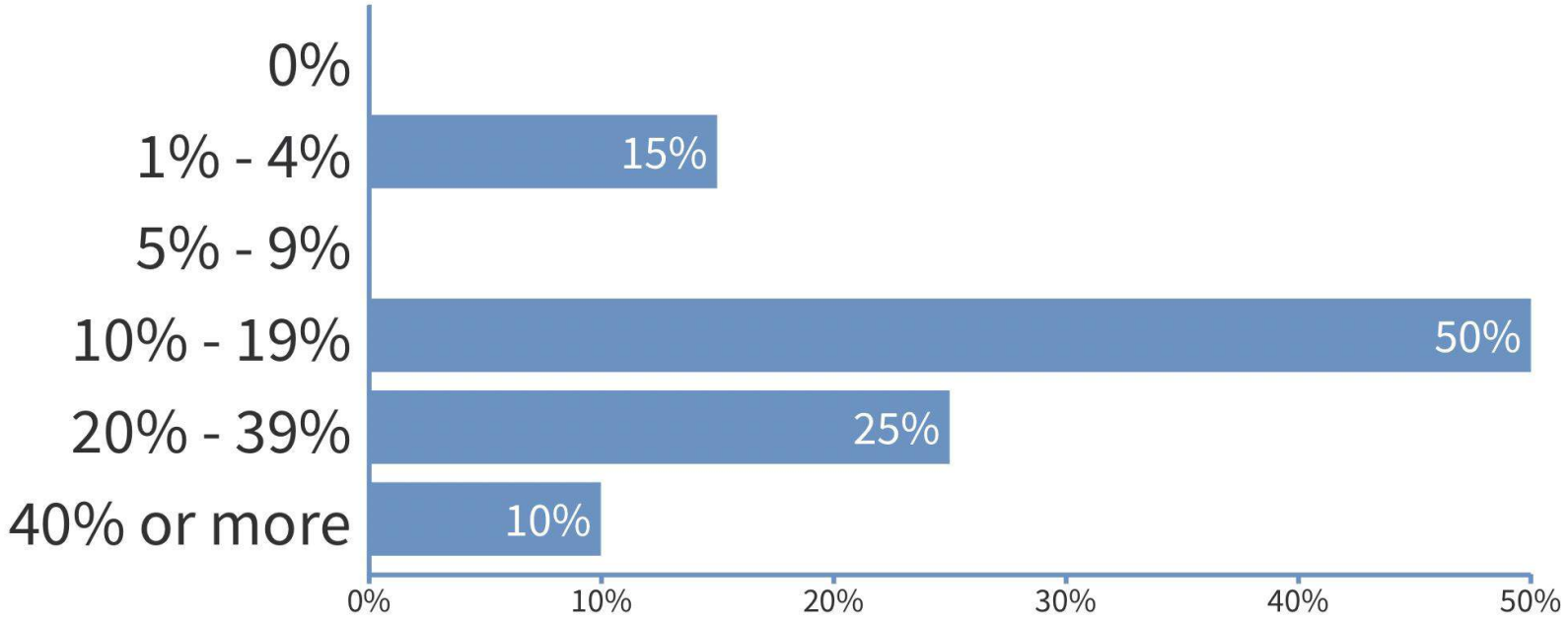
Cameron: 70.6% work 20+ hours (n=63).



Back

What percentage of your students are primary caregivers (to children and/or parents)?

When poll is active, respond at **PollEv.com/adammolnar929**



Poll Everywhere

Insert activity

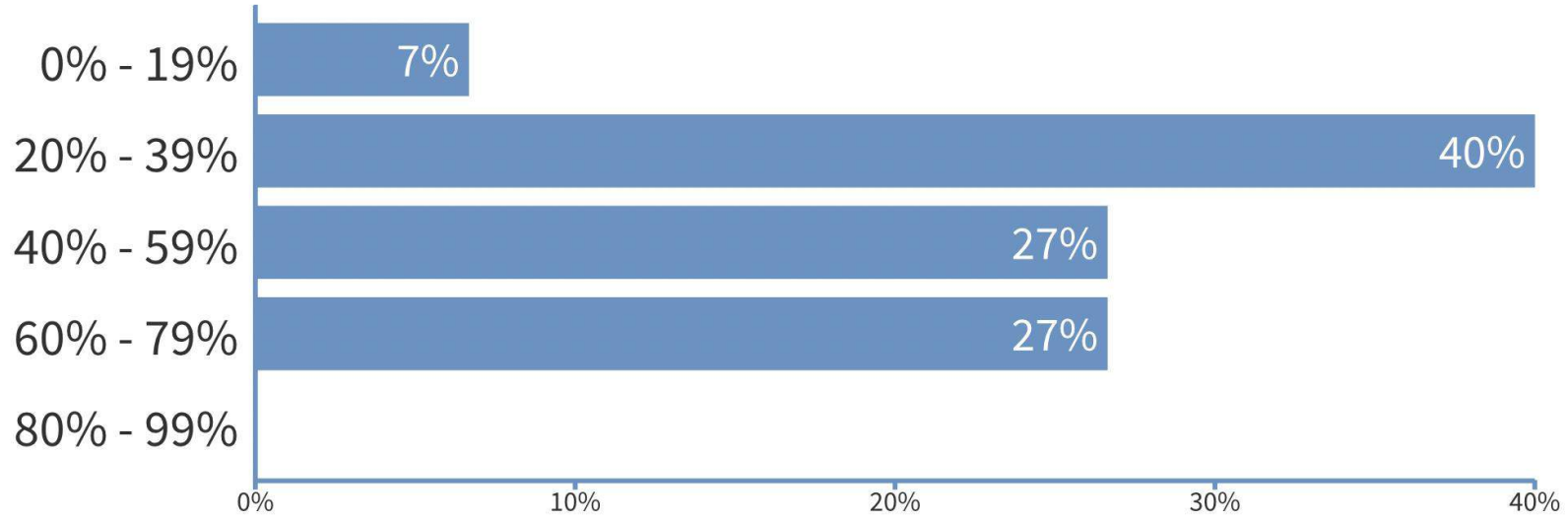
Cameron Data for Caregivers

- Of the 63 students surveyed in Spring 2019, 9 (14%) reported being a primary caregiver.
- Institutionally, the number believed to be a primary caregiver is believed to be north of 20% of the student population.

Back

What percentage of students at your school had a Math ACT score of 18 or lower (Math SAT 450 or lower)?

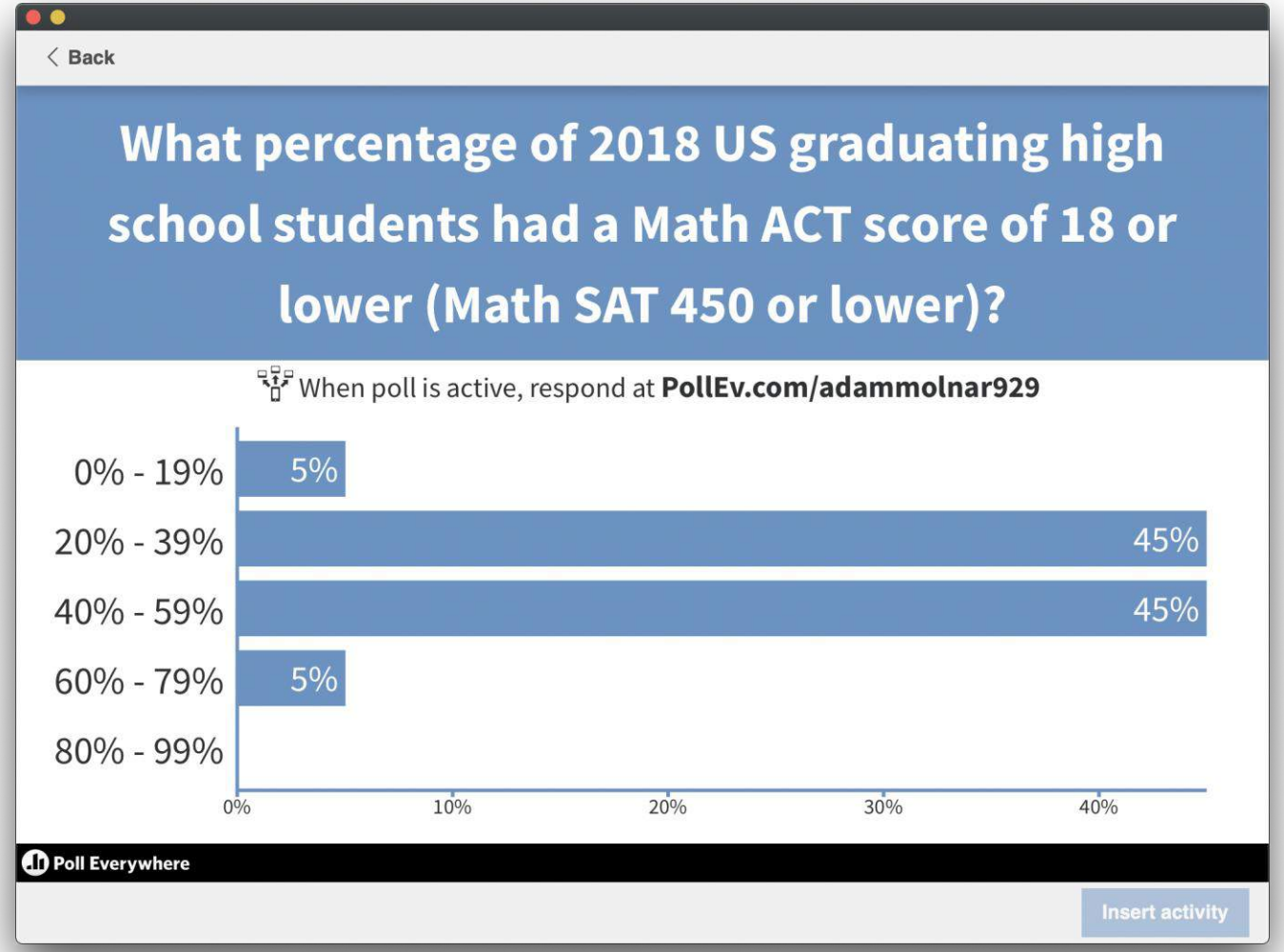
When poll is active, respond at **PollEv.com/adammolnar929**



Poll Everywhere

Insert activity

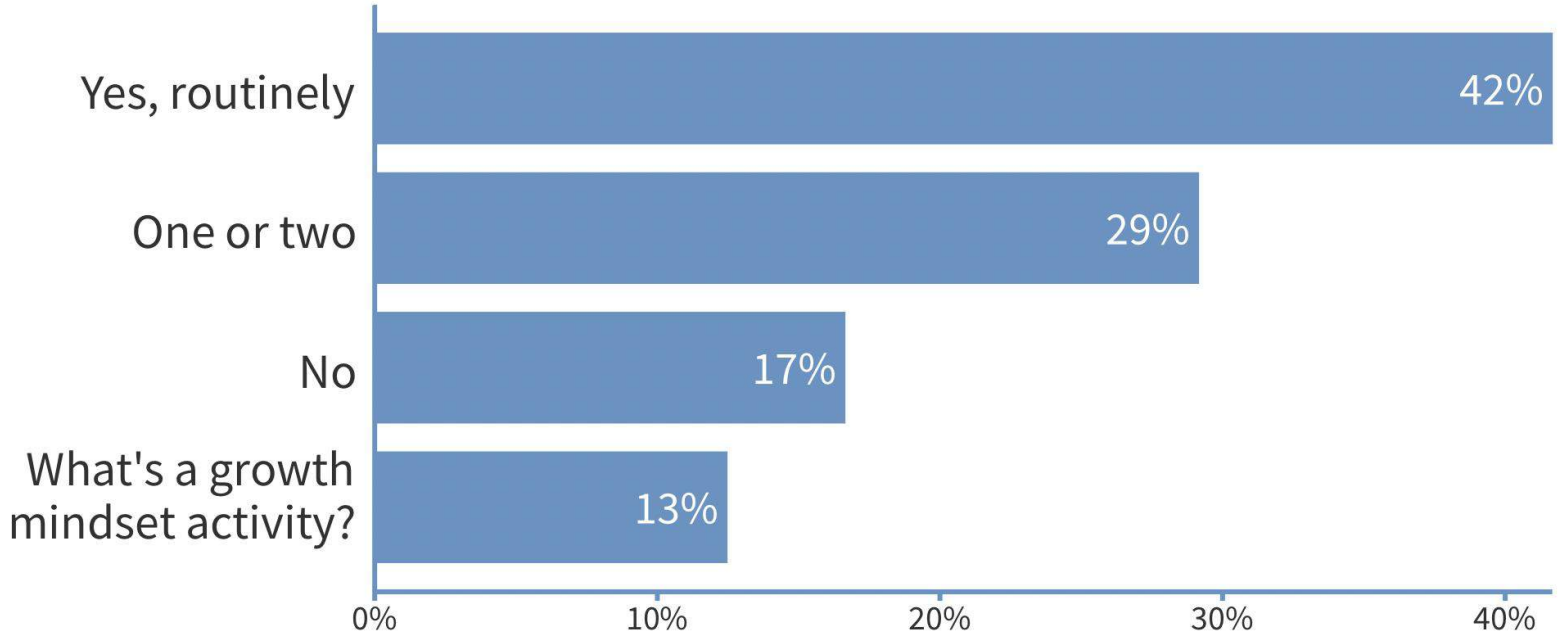
According to ACT: 45% of Test-Takers



Back

Do you implement growth mindset activities with your students?

When poll is active, respond at **PollEv.com/adammolnar929**



Poll Everywhere

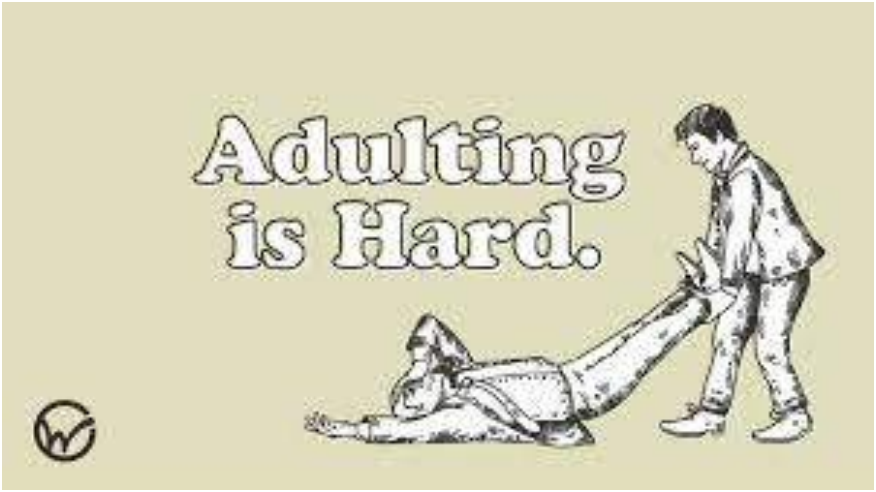
Insert activity

Students in Corequisite Classes

- By definition, a corequisite student is one who has not met the standard to enter a college-level course.
- Cameron: ACT 16 – 18
  Oklahoma State: ACT 19 – 21
- Corequisite students are often less prepared in aspects of life beyond mathematics ability.
  - How to learn mathematics
  - Time management
  - Attention management
  - Effort and mindset
  - Anxiety

Teachers in Corequisite Classes

- Corequisite teachers often have multiple roles.
  - Instructor
  - Cheerleader
  - Emotional Support
  - "Adulting" Coach



Some Issues in Implementing Corequisites

Concurrent Support

- There's always a level where students might need supplemental math support.
  - Intermediate algebra?
  - Matrix algebra for regression?
  - Multivariable calculus for continuous CDFs?
  - Real analysis for convergence?
- Multiple models listed in 2018 RAND report.
  - Paired course
  - Longer instructional time
  - Accelerated Learning Program (English)
  - Academic support service
  - Technology-mediated support

Scheduling Time

- Weekly amount of extra allocated time varies.
  - Oklahoma State: 150 statistics minutes + 50 corequisite
  - Cameron: 150 statistics minutes + 100 corequisite
  - Some schools have implemented more time, like 150 + 150.
- What about online corequisite courses?
  - Speedy feedback on problems matters more in corequisite courses, making face to face options more direct.
  - Evidence shows lower success rates online.
  - Cameron and OSU offer online introductory statistics, yet have not chosen to offer online corequisite support.

Putting Students Together

- **Cohort**: Statistics section is all corequisite students; students take statistics and corequisite together. Could use paired course, extra time, academic support, or technology. Most instructionally consistent, but most costly.
- **Comingled**: Designated statistics section contains corequisite and other students; corequisite students have separate additional time in paired course, academic support, or tech. Less expensive, but more complicated.
- **Bazaar**: Corequisite students can take any statistics section, with corequisite students combining into corequisite paired class, academic support, or technology.
  Most flexible, but instructionally challenging.

Paired Course: Developmental or Credit?

- Not college level (0-level)
- Generally does not transfer to other institutions.
- Sometimes restricted to first year or two of college.
- May not have financial aid.
- Easier to staff, because accreditation requires instructors have bachelor's, not master's degree.

- College level (1-level)
- Rarely transfers as requirement, but does transfer.
- Can be taken at any point during college career.
- Financial aid available.
- Requires instructors qualified with master's degree.

Developmental or Credit?

- Not college level (0-level)
- Generally does not transfer to other institutions.
- Sometimes restricted to first year or two of college.
- May not have financial aid.
- Easier to staff, because accreditation requires instructors have bachelor's, not master's degree.

- College level (1-level)
- Rarely transfers as requirement, but does transfer.
- Can be taken at any point during college career.
- Financial aid available.
- Requires instructors qualified with master's degree.

Or the Extended Time Lab Model?

- Corequisite treated as lab, with no additional credit hours.
- Led by lab assistants, even undergraduates.
- Funded through lab course fees.

Our Scheduling Experiences

- (2017-18) 0-level corequisite.
- (2018-19) Switch to 1-level for financial aid reasons.
- Comingled, same instructor for statistics and coreq.
- Standard tuition and fees for 2 credit hours.

- Lab model, extended class time, 150 minutes + 60.
- No distinction on transcript.
- (2018-19) Instructor led scheduling exception.
- (2019-20) Graduate TA leads corequisite, with lab fee.


100
FW H 8
FEDERAL RESERVE NOTE
LG 04727792 ★
G7
UNITED STATES FEDERAL RESERVE SYSTEM
Timothy F. Geithner
Secretary of the Treasury.
Rosa Gumataotao Rios
Treasurer of the United States.
100
FRANKLIN
ONE HUNDRED DOLLARS
THE UNITED STATES OF AMERICA
THIS NOTE IS LEGAL TENDER FOR ALL DEBTS, PUBLIC AND PRIVATE
JULY 4, 1776.
100
H 2
LG 04727792 ★
SERIES 2009 A
100

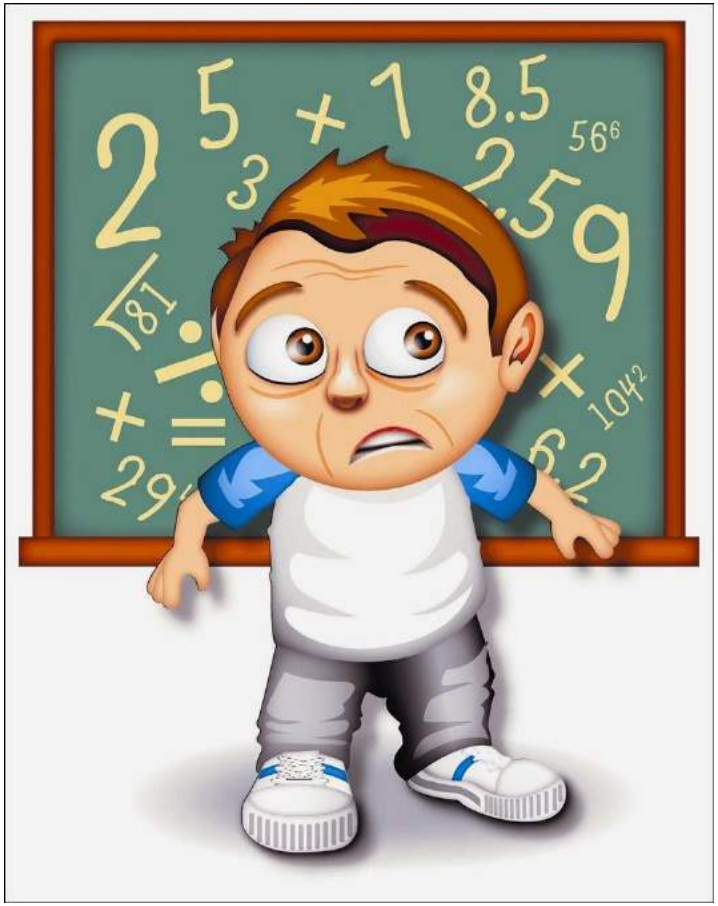
Grading

- Grading largely depends on the type of model and institution's intent for co-requisite courses.
- OSU does not assign separate lab grades.
- Since Cameron utilizes a comingled corequisite structure, the intent is to level-up weaker students. Cameron utilizes grading criteria that is primarily 30% attendance and 70% participation.
- Students who fail to attend corequisite can be dropped from both corequisite and primary courses. This is done because corequisite courses immediately proceed or follow their primary courses; failure to attend one will usually affect the other.

Technology (issues)

- Largest computer lab on Cameron's campus has 30 computers, with most labs having less than 25. Usual class size for Introduction to Statistics is 35.
- Since Introduction to Statistics is a 1000-level course, students are not required to take an introductory course on basic computer literacy.
- Getting students to purchase access to MyStatLab or a $12 scientific calculator can be extremely difficult. Requiring students to purchase a $100 TI-84 or providing loaners, would be difficult/impossible.

Corequisite Content



College Algebra?

- **Chapter 1. Equations And Inequalities**
  Linear equations and rational equations
  Applications of linear and rational equations
  Complex numbers
  Quadratic equations
  Applications of quadratic equations
  More equations and applications
  Linear, compound, absolute value inequalities
  Equations and inequalities for Calculus
- **Chapter 2. Functions And Graphs**
  The rectangular coordinate system
  Circles
  Functions and relations
  Linear equations in 2 variables, linear functions
  Applications of linear equations and modeling
  Transformations of graphs
  Analyzing graphs of functions and piecewise-defined functions
  Algebra of functions and function composition
- **Chapter 3. Polynomial And Rational Functions**
  Quadratic functions and applications
  Introduction to polynomial functions
  Division of polynomials and the remainder and factor theorems
  Zeros of polynomials
  Rational functions
  Variation
- **Chapter 4. Exponential And Logarithmic Functions**
  Inverse functions
  Exponential functions
  Logarithmic functions
  Properties of logarithms
  Exponential and logarithmic equations
  Modeling exponential, logarithmic functions
- **Chapter 5. Systems Of Equations And Inequalities**
  Systems of linear equations in 2 variables and applications
  Systems of nonlinear equations in 2 variables
  Sequences and series

It's Not College Algebra

- **Chapter 1. Equations And Inequalities**
  - Linear equations and rational equations
  - Applications of linear and rational equations
  - Complex numbers
  - Quadratic equations
  - Applications of quadratic equations
  - More equations and applications
  - Linear, compound, absolute value inequalities
  - Equations and inequalities for Calculus
- **Chapter 2. Functions And Graphs**
  - The rectangular coordinate system
  - Circles
  - Functions and relations
  - Linear equations in 2 variables, linear functions
  - Applications of linear equations and modeling
  - Transformations of graphs
  - Analyzing graphs of functions and piecewise-defined functions
  - Algebra of functions and function composition
- **Chapter 3. Polynomial And Rational Functions**
  - Quadratic functions and applications
  - Introduction to polynomial functions
  - Division of polynomials and the remainder and factor theorems
  - Zeros of polynomials
  - Rational functions
  - Variation
- **Chapter 4. Exponential And Logarithmic Functions**
  - Inverse functions
  - Exponential functions
  - Logarithmic functions
  - Properties of logarithms
  - Exponential and logarithmic equations
  - Modeling exponential, logarithmic functions
- **Chapter 5. Systems Of Equations And Inequalities**
  - Systems of linear equations in 2 variables and applications
  - Systems of nonlinear equations in 2 variables
  - Sequences and series

Suggested Topic Lists

- Mathematics Prerequisites for Success in Introductory Statistics, by Peck, Gould, Utts.
- http://dcmathpathways.org/resources/mathematics-prerequisites-success-introductory-statistics

- Day by day plan from Roane State CC, Tennessee.
- https://www2.calstate.edu/csu-system/why-the-csu-matters/graduation-initiative-2025/co-requisite-mathematics-summit/Handouts/Stat%20coreq%20sample%20timeline.docx

- Textbook publishers offer support options.

- Session Dropbox includes Cameron and OSU lists.

Backward Mapping

- Given a topic in statistics, what pre-requisite knowledge and skills are required?
- Backward mapping table includes
  - College-level objective
  - Prerequisite Skills
  - Taught in supplemental course
    Reviewed in college-level course
    Taught in college-level course
- Sourced from www.calstate.edu/app/mathqr/documents/co-req-development-backward-mapping.pdf

Example: Discrete or Continuous Variable?

Course task	Students need to be able to	Teach in support	Reinforce in course	Teach in course
Classify variables based on possible values of the variable	Determine sets of possible values			X
	Know set sizes: Finite, Countable like integers, Uncountable like real numbers	X (reals, integers, whole #)		X (not in Common Core)

Teach in course – Support task topics not in official prerequisite for entry.
Reinforce in course – Students should have seen the support task, but students' ability could be inconsistent.
Teach in support – Support task part of skipped mathematics,
OR important enough to merit more time.

Backward Mapping Small Groups

- Mean, standard deviation, and Z score for introductory statistics
- Conditional probability definition for introductory statistics
- Multiple regression analysis of variance F test for non-calculus linear regression second course

USCOTS 2019 Corequisite Breakout Adam Molnar and Christopher Sauer

Backward Mapping Topic: Mean, Std. Dev., and Z-score.

Course task	**Students need to be able to**	**Teach in support**	**Reinforce in course**	**Teach in course**
Calculate Sample Average	Understand Summation Notation	✓		✓
Calculate Sample Standard Deviation	Order of Operations	✓	✓	
Calculate Sample Standard Deviation	Know the Properties of Square Roots	✓	✓	
Calculate a Z-score given a mean, std. dev., and observation.		✓		✓
Determine an observation value given a z-score, mean, and std. dev.	Use properties of linear equations to solve for an unknown.	✓	✓	

Thoughts and Questions

Going Forward

- Open resource development
- Poster session (on math placement)
- Birds of a Feather lunch today

- Connections
- Sessions at larger statistics meetings?
- Virtual or face-to-face conference on corequisite statistics?

Thank You! 감사 합니다!

- Adam Molnar
  adam.molnar@okstate.edu
- Christopher Sauer
  csauer@cameron.edu

- Session Dropbox link:
  https://bit.ly/2WPjx8G
  https://www.dropbox.com/sh/xd79satxlcz4182/AAAb4TC4_HBmJxw-8bsb7Ndqa?dl=0